Sustainability and Green Construction

"A hundred years after we are gone and forgotten, those who never heard of us will be living with the results of our actions."

Oliver Wendell Homes

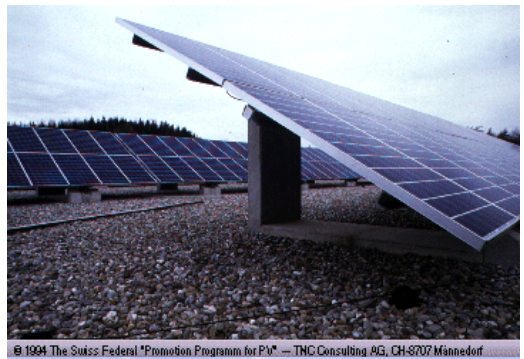
Sustainable design optimizes resources, restores and renews them, and provides an aesthetic that contributes in a positive manner, both now and in the future.

"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

Brundtland Commission report of 1987

Defining "Green"

- Metrics
  - External physical environment
  - Internal physical environment
- Environmental Impacts
- Worker Health and Productivity
  - Indoor Environmental Quality
    - Socioeconomic system
    - Organizational dynamics
- Economics
  - Market Transformation
- Policy



Mandates

Resource Conservation and Recovery Act (RCRA) Section 6002 (42 USC 6962), enacted in 1976, as amended

E.O. 13101, Greening the Government through Waste Prevention, Recycling, and Federal Acquisition - 14 Sep 98

E.O. 13123, Greening the Government through Efficient Energy Management - 3 June 99

E.O. 13148, Greening the Government Through Leadership in Environmental Management – 21 April 00

Federal Acquisition Regulations

Office of the Federal Environmental Executive

- Created by the 1993 **Executive Order 13123**
- Reports to the White House **Council of Environmental Quality**
- **OFEE's Vision:** A federal government that applies sustainable environmental practices
- **OFEE's** Mission: To promote sustainable environmental stewardship throughout the Federal government

OFEE's Tools and Methods

Sustainability Strategic Tools:

- Environmental Management Systems (EMS),
- Life Cycle Assessment, and
- Industrial Ecology

Sustainable Methods:

- Training and awareness
- Creating and expanding networks and facilitating dialogue
- Sharing success stories, lessons learned, and best practices
- Measuring and reporting
- Liaison to the Administration

OFEE's Mission

- Recycling & Waste Prevention,
- Environmentally Preferred Purchasing,
- Bio-based Purchasing,
- Green Buildings,
- Green Cleaning, and
- Electronics Stewardship

Federal Green Building Council

Facility Construction, Building Operations and Maintenance, and Deconstruction influence both human health and the external environment.

As Green Builders, we strive to:

- achieve the agency's functional mission,
- use sound financial practices,
- provide for health and safety, and
- protect and sustain the environment

Green Construction

- Performance Metrics: what is considered a "green" or "high performance" building?
- Research & Development efforts help in making the business case for Green Construction.
- Life Cycle Cost analysis and Life Cycle Assessment: benefits become clear when capital investments become linked to cash flows for operations and maintenance.
- Information-sharing Strategies: getting Green Building information to the right agency members helps to identify successful strategies, effective measures.

Philip Merrill Environmental Center
- a LEED Case Study -

Chesapeake Bay Foundation
Phillip Merrill Environmental Center
Annapolis, MD

Office of the Federal Environmental Executive

Audubon Center at Debs Park
- a LEED Case Study -

Los Angeles, Calif. (2003)

Green Purchasing Encompasses

- **Recycled content products , e.g., paper products, plastics, toner cartridges**
- **Energy- and water-efficient products**
  - **Energy Star**
  - **Standby power devices**
- **Alternative fuel vehicles and fuels, e.g., using battery-powered carts**
- **Biobased products: designated in 2005**
- **Environmentally preferable products**
- **Non-ozone depleting substances**

State of Green Buildings in the Federal government

To guide and direct interagency committee efforts, the Office of the Federal Environmental Executive surveyed government agencies on the status of:

- Performance Metrics,
- Research,
- Life cycle cost analysis and
  Life cycle cost assessment, and
- Information Sharing

Metrics:

Metrics

- Measure outcomes
- Identify performance goals, best practices, and policies
- Establish long term improvement objectives
- Identify barriers and solutions
- Measure performance and ensure implementation

Green Building Tools:
the LEED™ System

- LEED™ for New Construction
- LEED™ for Commercial Interiors
- LEED™ for Existing Buildings
- LEED™ for Core and Shell
- LEED™ for Homes

Research

- Short- and long-term costs and benefits
- Building performance
- Indoor environmental quality and productivity
- Product performance

Life Cycle Cost

- Life cycle cost
  - Assesses monetary return on investment through all stages of a sustainable building's useful life, including all components and systems, equipment and controls
  - Currently used for:
    - Energy-savings
    - Water conservation benefits

Life Cycle Assessment

- Life cycle assessment
  - Comprehensive system that analyzes the environmental impacts of a building's material, system, or equipment components.
  - allows decision-makers to analyze the resource inputs and outputs of building product and services, through each life stage.

Information Sharing

- Communication between agencies regarding sustainable building efforts
  - Use of existing research
  - Sharing of success stories
  - Guidance and assistance

Metrics:

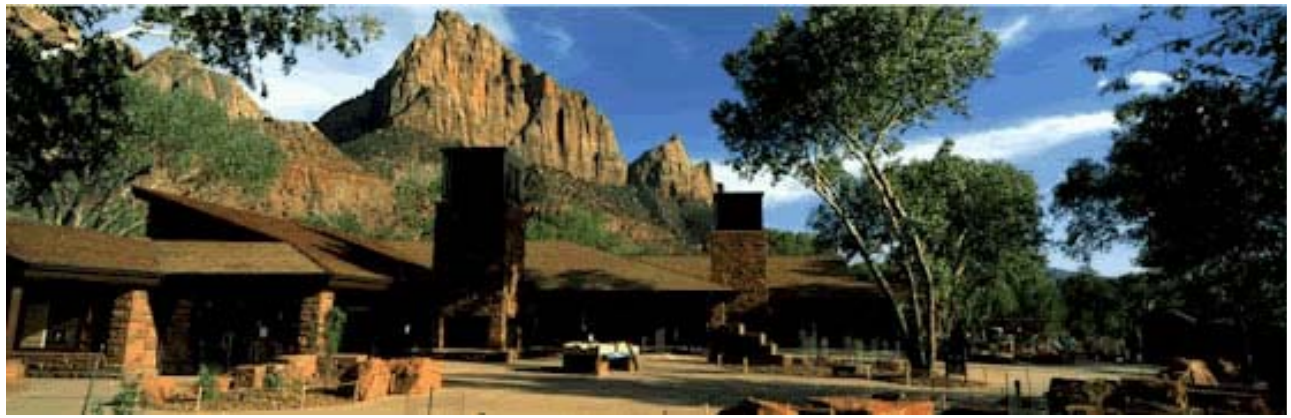
tools to assess a building's performance, and analyze its functionality and operating efficiencies

Questions: What performance metrics do you or others in your organization use to assess building performance, *e.g.*, energy usage, indoor air quality, and to assess the building's impacts on humans and the environment, *e.g.*, worker health, worker productivity? Are you developing or aware of others' work to develop such metrics? What metrics would you like to see used to assess federal green building efforts?

Responses:

Agencies measure energy and water output. Other areas, *e.g.*, human health and productivity, are key to our understanding of the effects.

Zion National Park Visitor Center
Springdale, Utah



Energy-Efficient Features:

- Trombe wall
- Photovoltaic (PV) system
- Lighting
- Glazing design and selection
- Passive down-draft cooltower
- Energy-efficient landscaping
- Natural ventilation
- Thermal mass flooring

Optimized overhangs

Research

Questions: What research are you conducting to assess building performance and the building's impact on humans and the environment? In your response, please include any such research you have under contract, and those others both within and outside of your organization are conducting. Are you developing research in these or other areas, or aware of others' research development? What research would you like to see conducted to assist with Federal green building efforts?

Response Overview: Respondents identified these significant research efforts currently underway :

- costs and benefits,
- building performance,
- indoor environmental quality and health and productivity,
- long-term economic benefits, and
- product performance.

Research cont'd

Respondents identified research gaps in the areas of:
- Building the Business Case for Sustainable design,
- Assessing federal government relevance of LEED EB, and
- Product Research

Research efforts currently underway include**:**

- **Green Building Costs and Benefits:** Federal Energy Management Program, Lawrence Berkeley National Laboratories (LBNL), and Economic Policy Research Institute
- **Building Performance:** LBNL, National Renewable Energy Labs (NREL)
- Energy and Water Use: TVA, EPA, DOE
- Energy Recovery: TVA
- Post-Occupancy Review of Green Building Engineering: PROBE (UK)

(cont'd)

Research cont'd

Research efforts currently underway also include:

- **Green House Gas Emissions:** Australia (http://www.facilityissues.com)
- USGBC's **LEED for Existing Buildings**
- **Healthy Buildings, Indoor Environmental Quality, Health, and Productivity:** NIH, UC Berkeley Center for the Built Environment, NREL, LBNL, and NASA
- **Long-term Economic Benefits of Sustainable Features:** EPA-green roofs
- **Product Performance:** TVA, University of Tennessee Center for Clean Products and Clean Technologies, Green Seal, State of California, Trane, NIST (BEES and BLCC)

Life Cycle Cost

Questions: What life cycle analysis and cost tools do you or others in your organization use for materials, systems, materials, buildings, or facilities? Are you developing or aware of others' work to develop such tools? What tools would you like to see developed to assist with federal green building efforts?

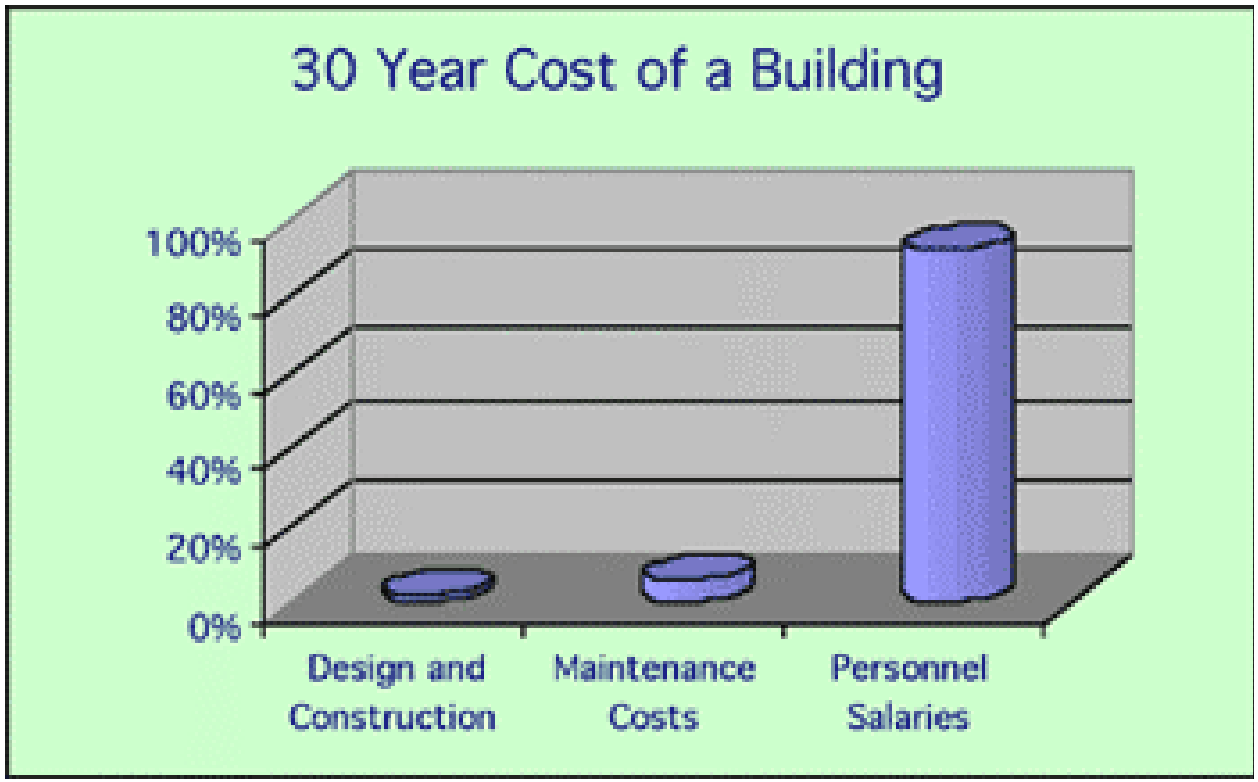
Responses: The existing lack of coordination between capital and operating budgets does not allow for enough opportunity or incentive to examine life-cycle issues:

- current practice compares first cost to obtain the lowest price products;

- budget line items for "sustainable" components are often eliminated;

- funding decisions are made independently for design, construction, and operations, and decisions are rarely based upon integrated cost analysis.

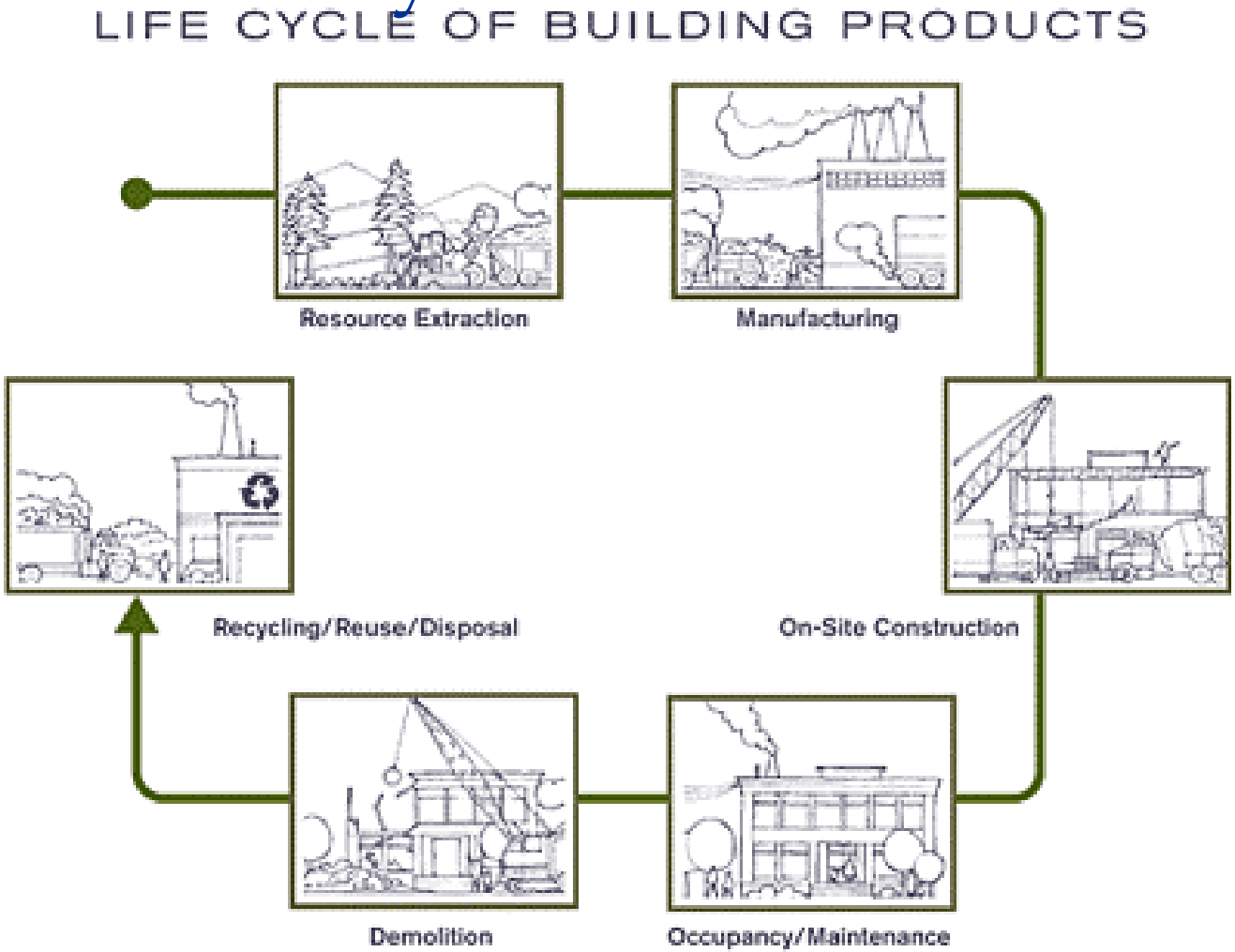
Life Cycle Cost



Viewed over a 30 year period, initial building costs account for approximately just 2% of the total, while operations and maintenance costs equal 6%, and personnel costs equal 92%.

Source: Sustainable Building Technical Manual

Life Cycle Assessment



Source: U.S. Department of Energy High Performance Buildings Database

Information Sharing

Questions: Are you interested in having information about green building work be more easily identified and shared across the Federal Government? What mechanism would best meet that need?

Responses: Respondents answer the first question about interest with a unanimous "Yes." Comments include:

- need to have information about green building work more easily identified and shared across the Federal Government, and
- to get information to the right people, especially the right management-level people.

Information Sharing cont'd

- In response to the second question, respondents identified a number of specific websites: the Whole Building Design Guide, plus Federal agency sites.

- Web sites must be well-organized, well-packaged and maintained with current information and made available to all Federal agency personnel.

Websites

- EPA www.epa.gov/greenbuilding, www.epa.gov/greeningepa,
- DOE www.eere.energy.gov/building
- Department of Defense https://tsc.wes.army.mil/default.asp, http://rpm.wes.army.mil, and SustainNet, hosted on the Defense Environmental Network and Information Exchange (DENIX)

Metrics Summary

The Federal Green Building Council should task staff to identify performance metrics, analyzing:

- How much construction and demolition debris is generated and recycled;
- How best to measure Indoor Environmental Quality: pollution, chemistry, ventilation rates, air movement, air pollutants, toxic irritants in building projects and mechanical effects, temperature, microorganisms, and environmental versus psychological factors;
- Health and productivity effects, such as how agency staff may relate differently in sustainably designed buildings; and
- How budgets for design, construction, and operations drive design decisions and whether design strategies translate into actual building performance

Research Summary

The Federal Green Building Council should task staff to develop plans for further research on:

- Business case for sustainable design
  - Life cycle costing/return on investment
  - Building performance
    - Building performance (cooling tower, lighting loads/floor)
    - Metric development/indicators for sustainability reporting
    - Building metering location efficiency
    - Impact on the environment
  - Building environmental impact assessment
  - Continuous improvements of federal green building
- Assess LEED EB (USGBC)
- Products (renewable resources, prefabricated modular housing efficiency)

Life Cycle Cost and Assessment Summary

The Federal Green Building Council should task staff, in implementing LCC and LCA tools, to:

- Identify current LCC and LCA tools' strengths and shortcoming;
- Decide how current LCC and LCA tools can be improved, and better implemented, and more widely understood;
- Identify how best to improve training and education efforts (including for OMB and legislative officials); and
- Determine whether new or additional guidance or rules are needed.

Information Sharing Summary

The Council should task staff to:

- determine whether existing web sites are adequate or a single centralized source for sharing information is more effective.

GSA's San Francisco Federal Building

Next Steps for Federal Green Building

- Improve current Metric and LCC and LCA tools;
- Conduct further research where major gaps exist, as in LCC and LCA, return on green building investment, building performance, and environmental impacts;
- Educate staff on using current Metric and LCC and LCA tools;
- Determine whether existing websites are adequate as a centralized source for information sharing –- if necessary, develop a new website.

Office of the Federal Environmental Executive (OFEE)

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